APPENDIX H RESEARCH/MONITORING ACTIONS PURSUANT TO THE RPA

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As described in Section 9.6.5.5, some of the research and monitoring activities associated with the RPA can be anticipated in sufficient detail now, based on elements of the RPA described in Section 9.6.1. The RPA therefore instructs the Action Agencies to implement the activities listed below.

H.1 RESEARCH AND MONITORING ACTIVITIES

Research Action 900: Research to determine the relative survival of migrating juvenile salmonids passing through the spillway of The Dalles Dam. Run-of-the-river fish, including ESA-listed fish, will be collected at John Day Dam and/or obtained from the smolt monitoring program. Study fish will be handled (anesthetized and sorted) and released or PIT-tagged, transported to The Dalles Dam, held for up to 24 hours, and released at selected locations. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.4.5 and 9.6.1.4.6.

Research Action 946: Research to assess the migration timing and relative survival of transported and inriver juvenile chinook salmon migrating volitionally from Bonneville Dam to the mouth of the Columbia River. Run-of-river fish, including ESA-listed juvenile fish, will be observed/harassed while they pass through a PIT-tag interrogation net or captured, anesthetized, examined for PIT-tags and the degree of descaling, allowed to recover from the anesthetic, and released. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.3.3 and 9.6.5.3.5.1.

Research Action 994: Research to assess the passage success of migrating adult salmonids at the eight dams and reservoirs on the lower Columbia and the lower Snake rivers, to evaluate specific flow and spill conditions, and to evaluate measures to improve adult anadromous fish passage. Adult salmonids will be captured at Bonneville, Ice Harbor, and/or Lower Granite dams, anesthetized, fitted with radio transmitters and identifier tags, allowed to recover from the anesthetic, transported, and released. Once the fish are returned to the river, the movement and migration timing of each fish will be recorded at fixed-site and mobile receiver stations as the fish migrate upstream. The primary benefits of the research will be identifying problematic areas in the migration corridor for adult passage and determining the proportion of salmonids that ultimately pass the upstream dams and enter tributaries to spawn, that enter hatcheries, that are taken in fisheries, or that are losses. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.2.6, 9.6.1.6.2, and 9.6.1.7.2.

Research Action 996: Research to monitor the effects of the juvenile fish bypass system at Ice Harbor Dam on the Snake River in Washington. Run-of-the-river juvenile fish, a proportion of which will be ESA-listed fish, will be collected from the bypass system at the dam, anesthetized, handled, allowed to recover from the anesthetic, and released. The primary purpose of the sampling is to ascertain fish condition and, thereby, to certify that the bypass system functions

correctly. Some adult fish, including ESA-listed adult salmon, are expected to fall back through the juvenile bypass system and be captured and handled in the effort to return them to the river. The research is necessary to satisfy elements of the RPA described in Section 9.6.1.4.5.

Research Action 1036: Research to document the growth, migration timing, survival, and SARs for wild juvenile fall chinook salmon migrating from the Snake River to the mouth of the Columbia River. Wild fall chinook salmon will be collected along the Hells Canyon Reach of the Snake River and PIT-tagged. The results will be used to monitor the effects of supplementation, to forecast passage at Lower Granite Dam to help plan summer flow augmentation, and to assess the relative impacts due to predation. Observed migration timing and survival will be used to evaluate the effectiveness of summer flow augmentation. If feasible, one group of PIT-tagged fish will be transported from Lower Granite Dam, and another group will be allowed to continue inriver migration. The research consists of six assessment tasks for which ESA-listed fish will be taken: 1) life cycle, 2) food and growth, 3) predation, 4) temperature response, 5) migratory behavior, and 6) race and residualism. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.2.1, 9.6.1.2.6, 9.6.1.3.3, 9.6.1.5.2, 9.6.1.7.2, 9.6.2.1, and 9.6.5.3.5.

Research Action 1058: Research designed to monitor and evaluate adult returns of hatcheryorigin fall chinook salmon released as juveniles above Lower Granite Dam on the Snake River.
Information on ESA-listed, natural-origin fish is needed to assess the impacts of fish
management (e.g., hatchery supplementation) and other human activities (e.g., regulated river
flows) on wild fish populations. The research has two components: 1) radio-tagging returning
adult salmon at Lower Granite Dam to document the movements and spawning distribution of
known natural-origin fall chinook salmon above the dam and 2) collecting data and scale or
tissue samples from spawned-out adult fish in the Snake River and tributaries above Lower
Granite Dam to augment information on spawning distribution collected from the radio-tagged
fish. The research is necessary to satisfy elements of the RPA described in Section 9.6.1.6.2.

Research Action 1130: Research to determine the movement, distribution, and passage behavior of radio-tagged juvenile salmonids at Bonneville, The Dalles, and John Day dams on the lower Columbia River. The results will be used to assess fish passage efficiency at John Day and The Dalles dams and to increase bypass efficiency for juvenile salmonids at the dams by designing and positioning prototype surface bypass/collection structures. ESA-listed fish will be acquired from smolt-monitoring program personnel at Bonneville, John Day, and/or McNary dams, implanted with radio transmitters, transported, held for as long as 24 hours, released, and tracked electronically. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.4.5 and 9.6.1.4.6.

Research Action 1136: Research to compare the biological and physiological indices of wild and hatchery juvenile fish exposed to stress from bypass, collection, and transportation at the dams on the lower Snake and Columbia rivers. The goal is to provide information that can be used to improve outmigrating juvenile salmonid survival by determining the effects of manmade structures and management activities on the fish. ESA-listed juvenile fish will be captured at Lower Granite and Little Goose dams on the lower Snake River and at Bonneville, John Day, and McNary dams on the lower Columbia River, or acquired from smolt-monitoring-program personnel. The captured juvenile fish will be examined and released or tagged with radio transmitters, released, and tracked electronically. A lethal take of ESA-listed juvenile fish will also occur. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.3.3, 9.6.1.3.4, and 9.6.1.4.6.

Research Action 1193: Research to produce information on migrational characteristics of Columbia and Snake river basin salmon and steelhead. The smolt monitoring program produces information on the migrational characteristics of the various salmon and steelhead stocks in the Columbia and Snake River basins and provides management information for implementing flow and spill measures designed to improve fish passage conditions in the mainstem lower Snake and Columbia rivers. The smolt-monitoring sites include tributary monitoring at the Whitebird trap on the Salmon River, the lower Grande Ronde River trap, and the Lewiston (Snake River) trap. The program also includes monitoring at Lower Granite, Little Goose, Lower Monumental, McNary, and John Day dams and at Bonneville Dam First and Second Powerhouses. Monitoring, including tagging actively migrating smolts with PITs at the tributary traps, yields information on migration timing to FCRPS dams, travel time, and relative survival data from release to Lower Granite Dam, the first dam encountered by outmigrating Snake River salmonids. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1 and 9.6.5.3.5.1.

Research Action 1194: Research to develop and evaluate adult PIT-tag interrogation systems for future installation at mainstem FCRPS facilities on the lower Columbia and Snake rivers. Studies will evaluate the ability of new PIT-tag detection technology to detect and read tag codes in orifices of fish ladders and to evaluate the effects of the detection system on the behavior of adults as they approach the system and pass through. Initial efforts will provide information about adult salmonid behavior during passage through Bonneville Dam and will help evaluate fish passage at other hydropower dams in the future. The new technology will allow tag readings from a greater distance than is currently feasible to allow data collection in a more natural fishway environment. The study is directed at nonlisted adult hatchery fish, but authorization is provided for ESA-listed adult hatchery fish because they often cannot be distinguished while collecting run-of-the-river fish. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.3.3, 9.6.1.3.4, and 9.6.5.3.5.2.

Research Action 1212: Research consisting of four studies at the hydropower dams on the lower Snake and Columbia rivers. Study 1 will provide up-to-date survival estimates of juvenile salmonids as they migrate past McNary Dam. Study 2 will identify specific trouble areas in the juvenile fish bypass system at Lower Monumental Dam. Study 3 will compare the performance of juvenile salmonids tagged with sham radio-transmitters with the performance of juvenile salmonids PIT-tagged at Lower Granite Dam. The use of radio tags reduces research fish requirements, but the larger tag size could affect fish behavior. If survival studies can be conducted with radio-tagged juveniles, handling of ESA-listed species for important research would be significantly reduced. Study 4 will determine the tailrace residence times and behavior of radio-tagged hatchery chinook salmon under various operational conditions at Lower Monumental Dam and will identify spill conditions that maximize fish passage efficiency at Ice Harbor Dam. The research will be used to develop corrective measures to improve juvenile fish passage at the dams. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.4.5, 9.6.1.4.6, and 9.6.5.3.5.1.

Research Action 1224: Research to evaluate the conversion rates (i.e., survival through the FCRPS), travel times, and passage routes of adult steelhead that have spawned (kelts) and are emigrating past hydroelectric facilities on their migration back to the ocean. Fish will be obtained from smolt-monitoring-program personnel at John Day and McNary dams on the lower Columbia River, anesthetized, handled (examined for spawning condition, length, fin condition, and descaling), and released, or they will be obtained from smolt-monitoring-program personnel, tagged/marked (tagged with PIT, radio-telemetry, or visual implant tags), and released. Fish migrating past downstream dams and reservoirs will be monitored by aerial and underwater telemetry arrays. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.6.2 and 9.6.5.3.5.2.

Research Action 1240: Research to provide fishery managers with detailed information on the response of outmigrating juvenile anadromous salmon to operation of a prototype surface bypass structure (removable spillway weir) at Lower Granite Dam. Juvenile fish for the study will be collected at preselected trap sites operated by smolt monitoring program personnel. ESA-listed juvenile fish may also be collected by purse seine in Lower Granite reservoir or from smolt monitoring program personnel at Lower Granite Dam. The fish will then be transported as necessary, anesthetized, implanted with radio transmitters, allowed to recover, transported to an upstream release site, released, and tracked electronically. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.4.5 and 9.6.1.4.6.

Research Action 1241: Studies to provide fishery managers with data on the timing, passage, and survival of outmigrating juvenile salmonids in relation to the operations of John Day, The Dalles, and Bonneville dams. Fish for the study will be collected from the juvenile fish bypass facilities at Bonneville, John Day, and/or McNary dams on the lower Columbia River by smolt

monitoring program personnel. The fish will then be transported as necessary, anesthetized, implanted with radio transmitters, allowed to recover, transported to an upstream release site, released, and tracked electronically. Some research tasks will result in lethal takes of ESA-listed juvenile fish. Those tasks are designed to 1) statistically evaluate the survival rates of juvenile salmonids through John Day, The Dalles, and Bonneville dams and 2) evaluate the stress of juvenile salmonids that pass through the new bypass outfall pipe at Bonneville Dam Second Powerhouse DSM by measuring physiological indices (blood cortisol and lactate concentrations). For item 1), above, fish will be acquired from smolt monitoring program personnel at the dams, exposed to a lethal dose of anesthetic, and released in paired groups with the live radio-tagged fish to test the potential for dead research fish to be mistaken for live research fish. For item 2), run-of-the-river fish will be netted from the sampling flume at Bonneville Dam to acquire the target fish; ESA-listed juvenile fish will be captured, handled, and released, or captured and sacrificed. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.4.5 and 9.6.5.3.5.1.

Research Action 1242: Research to evaluate inriver migration survival versus transportation survival from Lower Granite Dam to below Bonneville Dam. Whether the transportation of depressed anadromous fish species should be maximized to enhance recovery is one of the most controversial and critical questions before fisheries managers today. Among other work, this research is designed to provide definitive information on this important question. ESA-listed juvenile fish will be captured at Lower Granite Dam, handled (checked for condition), and released, or they will be captured at Lower Granite Dam, PIT-tagged, and returned to the river below the dam. Study fish will be tracked downriver as juveniles, and when they return to the Snake River basin as adults, by using automated PIT-tag detectors at the mainstem FCRPS dams. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.3.3 and 9.6.1.3.4.

Research Action 1243: Research to evaluate juvenile fish survival through the Ice Harbor Dam spillway on the Snake River. Survival estimates for juvenile chinook salmon that migrate through the reservoirs, hydroelectric projects, and free-flowing sections of the Snake and Columbia rivers are essential for developing effective strategies to recover depressed stocks. Recent survival studies have evaluated passage through various routes at all of the dams on the lower Snake River except Ice Harbor Dam. ESA-listed juvenile fish will be collected at Lower Monumental Dam on the Snake River by smolt-monitoring-program personnel. The fish will then be tagged with radio transmitters and/or PITs, transported to Ice Harbor Dam, held for recovery, and released into the spillway or transferred to a small barge, transported, and released into the tailrace. Tagged fish will be tracked downriver as juveniles, and later when they return to the Snake River as adults, using automated PIT-tag detectors at FCRPS dams. The research is necessary to satisfy elements of the RPA described in Section 9.6.1.4.5.

Research Action 1244: Six research studies to evaluate juvenile fish collection/bypass facilities at selected Snake and Columbia river FCRPS dams. Problems associated with juvenile fish passage through mainstem FCRPS facilities are major factors in the decline of ESA-listed anadromous fish species. Based on the results of bypass studies, guidance devices and bypass system components can be redesigned, modified, or deployed using specific configurations to improve juvenile fish passage. ESA-listed juvenile fish will be collected at Ice Harbor Dam on the Snake River (study 1) and at McNary (studies 2 and 3) and Bonneville dams (studies 4, 5, and 6) on the Columbia River. Once collected, the fish will be routed to holding tanks, handled (checked for fish condition and fork length), and released or routed to holding tanks, tagged/marked (with PITs, radio transmitters, and/or fin clips), and released. For study 4, artificially propagated chinook salmon juveniles will be PIT-tagged at the Idaho Department of Fish and Game's McCall Hatchery in Idaho. Tagged fish will be tracked downriver as juveniles, and later when they return to the Columbia and Snake river basins as adults, using automated PIT-tag detectors at FCRPS dams. Lethal takes of ESA-listed juvenile fish will occur for studies 2, 4, and 5. For study 4, previously PIT-tagged hatchery yearling chinook salmon will be collected at Bonneville Dam, held in artificial seawater for extended periods, and ultimately sacrificed for physiological characteristics and disease profiles. For study 5, ESA-listed juvenile fish that are not guided by intake screens will be collected in fyke nets as a way to estimate the number of unguided fish during the FGE research on submersible traveling screens at that dam. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.4.5 and 9.6.5.3.5.1.

Research Action 2000: Research at several mainstem FCRPS dams (Lower Granite, Little Goose, Lower Monumental, and McNary dams) to identify and enumerate adult steelhead kelts that pass through associated juvenile fish bypass facilities by using mark-recapture methods. Corps project personnel will remove ESA-listed adult steelhead from the juvenile fish separators during their downstream emigration, examine them using ultrasound, treat them for parasites, mark them (with Floy anchor tags, radio transmitters, or PITs), and release them into the tailrace through the flume used to remove adults from the wet separator. Alternatively, the fish will be held for up to 3 days, transported, and released below Bonneville Dam. A small (0.5 cm²) piece of fin tissue will be excised. Up to 5 ml of milt will be collected from a maximum of 60 wild male steelhead that 1) are positively identified by ultrasound as kelts, 2) are in good condition, and 3) are readily able to express milt. The samples will be useful in future population restoration efforts, in conjunction with the population of origin identification provided by DNA analysis. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.6.2 and 9.6.5.3.5.2.

Research Action 2001: Research to collect relevant information for lower Columbia River fall chinook and chum salmon so that recommendations can be made for configuration and operation of the FCRPS to protect and/or enhance mainstem spawning populations. Additional studies are

planned to characterize stranding of juvenile fish associated with fluctuating stream flows (due to FCRPS operations). The project will provide baseline data to properly manage natural spawning fall chinook and chum salmon in the mainstem Columbia River downstream of McNary Dam. Research will also evaluate the effects of fluctuating flows and power system load on fall chinook and chum salmon and their habitat as outlined in NWPPC (1994). The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.2.1, 9.6.1.2.3, and 9.6.5.3.3.

Research Action 2002: Research to evaluate modifications to the juvenile fish PIT-tag diversion systems at Lower Granite and Little Goose dams on the Snake River. The evaluation will include fish condition (descaling, injury, and mortality rates), travel time, detection efficiency, and relative survival for PIT-tagged fish. In addition, primary bypass survival will be compared with PIT-tag bypass survival, and a new three-way, diversion sampling system will be evaluated at Little Goose Dam. If injuries, descaling, or mortalities for PIT-tagged fish passing through the modified PIT-tag diversion systems are observed, additional PIT-tagged fish will be released at various locations along the passage route to determine where injuries or descaling occur. The research is necessary to satisfy elements of the RPA described in Section 9.6.1.4.5.

Research Action 2003: Research to compare SARs of marked yearling and subyearling chinook salmon and steelhead juveniles transported from McNary Dam to below Bonneville Dam with the SARs of marked inriver migrating juveniles of these species released into the tailrace of McNary Dam. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.3.3 and 9.6.1.3.4.

Research Action 2004: Research to identify empirically the benefit to juvenile salmon of tidal freshwater and oligohaline transition zones in the Columbia River estuary. The long history of wetland loss in the Columbia River estuary, coupled with changed flow patterns, suggests that restoring these habitats may benefit the recovery of depressed salmon stocks. Habitat-salmon linkages in the Cathlamet Bay region (upstream of Tongue Point) will be evaluated using a combined monitoring and modeling approach to identify and validate the salmon-habitat associations in the lower Columbia River and estuary. That information will be coupled with a historical reconstruction of flow and sediment input in the system and a historical reconstruction of critical salmon habitat change using the geographic information system (GIS) to compare the historical data with present conditions. The approach will be to determine the relationship among shallow water habitats and the presence, use, and benefit to juvenile salmon (emphasizing subyearling chinook salmon) in the Columbia River estuary; understand change in flow and sediment input to the Columbia River estuary in the past and change in habitat availability throughout the lower river and estuary; and develop a numerical model of the lower Columbia River and estuary that can be used to evaluate associations between salmon use and habitat affected by both natural processes and human actions. The research is necessary to satisfy elements of the RPA described in Section 9.6.5.3.6.

Research Action 2005: Research to quantify the abundance of potential predators before and after a trash boom is installed in the forebay of Little Goose Dam. Potential predator fishes (smallmouth bass-*Micropterus dolomieu*, northern pikeminnow-*Ptychocheilus oregonensis*, and channel catfish-*Ictalurus punctatus*) will be collected using nighttime boat electrofishing along the shoreline (effective depth 2 to 4 m) and baited set-lines in deeper water. Sampling will be conducted for 3 to 4 nights over each 2-week period during the study until an acceptable population estimate (±95% confidence interval) can be determined. Adult and juvenile salmonids that encounter the electrical field are expected to move rapidly out of it. As proposed, sampling will cover the area along both the south and north shorelines and open water from Little Goose Dam (approximately RM 70) upstream to approximately RM 71.4. Most predator fishes will be marked with a Floy tag, except for about 50 individuals of all species that will be used for radiotelemetry distribution studies. The recapture of marked fish will make it possible to calculate predator populations by using closed and open population estimators before and after installation of the trash boom. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.4.5 and 9.6.1.5.2.

Research Action 2006: Research designed to evaluate the large-scale predation patterns of northern pikeminnow on juvenile salmonids and American shad (BPA project 9007800). The goal is to investigate large, systemwide (upriver versus downriver) patterns in predation processes, which may have consequences for salmonid survival and management. The largescale patterns may include higher rates of predation on salmonids and higher growth and reproductive rates for predators in the Columbia River below Bonneville Dam than in the Columbia or lower Snake river reservoirs. The primary task will be to collect data on the size, age structure, and growth of northern pikeminnow populations at upriver versus downriver locations. Temporal variation in northern pikeminnow predation rates and diet will be emphasized. Two particular hypotheses will be examined: 1) temperature differences in the mainstem rivers can explain predation patterns, and 2) the abundance of alternative prey, especially juvenile American shad, can explain predation patterns. Boat electroshocking will be used to collect northern pikeminnow annually during May through October in the tailrace areas of Bonneville, The Dalles, and McNary dams on the Columbia River and at Lower Monumental Dam on the lower Snake River. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.5.1, 9.6.1.5.2, 9.6.1.5.3, and 9.7.1.5.

Research Action 2007: Research on the energy expenditure of upstream migrating adult salmon and steelhead in the Columbia and Snake rivers, for assessing the potential influence of delay, fallback, water temperature, and dam operations (e.g., spill) on migration energetics and, ultimately, on the reproductive performance of these fish. Adult spring chinook salmon en route to upstream locations will be collected from the Bonneville Dam collection facility. The fish will be surgically tagged with electromyogram/temperature radio transmitters and released either downstream or upstream of the Bradford Island fishway. The fish will be tracked using both

mobile and fixed receivers and antennas. Telemetered electromyograms and fish temperature data will be collected as the fish move upstream through the tailrace, fishway, and forebay of Bonneville Dam (or other projects recommended by fish managers). Some of the fish will be tracked through Bonneville pool to the tailrace of The Dalles Dam. The research, funded by the Corps, will begin in 2001 and continue for an undetermined number of years. The research is necessary to satisfy elements of the RPA described in Sections 9.6.1.2.6, 9.6.1.6.2, and 9.6.1.7.2.

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H.2 ESTIMATES OF TAKE ASSOCIATED WITH JUVENILE FISH RESEARCH/MONITORING

Juvenile fish passage research and monitoring are required by the RPA. Most of the research and monitoring activities identified in this biological opinion will take place on the mainstem lower Columbia and Snake rivers or at the mainstem, Federally operated hydropower dams. The scientific research and monitoring activities, compared with the overall effects of FCRPS operation, will cause relatively small effects on ESA-listed species and will not present any significant effects beyond those already estimated through other means (SIMPAS modeling). The application of information from research and monitoring is expected to benefit the survival of ESA-listed species.

Some scientific research and monitoring activities evaluated in the take tables that follow (Tables H-1 to H-12) are multiyear projects that will require annual takes of ESA-listed species. NMFS must assess the cumulative impacts to ESA-listed anadromous fish species that result from annual research and monitoring. Cumulative impacts on ESA-listed fish are best expressed as total annual rates of mortality per individual ESU. To assess annual cumulative impacts due to scientific research and monitoring, NMFS will require each Action Agency (or its designated contract researcher) to submit a take report at the end of each annual sampling season. On the basis of the annual report, each research and monitoring activity will be subject to annual authorization by NMFS. For fish research and monitoring on the mainstem rivers, a cumulative impact assessment is not sensitive enough to evaluate the effects of scientific research and monitoring on ESA-listed salmonids at the population level. Annual cumulative impact analyses will treat the effects on ESA-listed fish populations the same as effects on the ESU as a whole.

Annual-take estimates of ESA-listed juvenile fish associated with scientific research activities are derived from preseason estimates of abundance for each species at various hydropower dams on the mainstem Snake and Columbia rivers. Abundance estimates of outmigrating juvenile salmonids are calculated every year, using an algorithm NWFSC developed, and are distributed to the Action Agencies, researchers, and regional comanagers for the derivation of annual take estimates. The take estimates in this biological opinion were developed from the abundance estimates for the 2000 juvenile fish outmigration (Schiewe 2000). The juvenile outmigration estimates are calculated assuming a full transportation with spill scenario. The abundance estimates of ESA-listed juvenile salmonids can vary significantly from year to year, so the estimates will have to be revised in subsequent years as more complete scientific information is acquired. One of the objectives of the research proposed in this biological opinion is to obtain data for improving the precision of future abundance estimates.

Table H-1. Annual-take estimates of ESA-listed juvenile salmonids: SR sockeye salmon.

Research		Hand	d le			
Action	Location	% of Listed Run	#s in 2000	Tag	Mortality	Lethal
900	JDA	0.198	30		0	
946	EST	2.691	408		0	
996	IHR	0.093	29		1	
1136	LGR	0.0008	4		0	
	MCN	0.0026	1		0	
	JDA	0.0023	1		0	
	BON	0.0036	1		0	
1193	WhT	0.100	20		0	
	LeT	9.900	1,500		30	
	LGR	13.200	2,000		40	
	LGS	9.900	1,500		30	
	LMN	6.600	1,000		20	
	MCN	1.300	200		4	
	JDA	0.500	75		2	
	BON	0.300	50		1	
1212	LGR	2.315	351		4	
	LMN	1.049	159		2	
1240	LGR	0.002	44		2	
1242	LGR	56.964	8,638		211	
1243	LMN	1.286	195		2	
1244	IHR	2.420	367		4	
	MCN	0.310	47		0	
	JDA	0.014	2		0	
	BON	0.053	8		0	8
2002	LGS	2.585	392		9	
2003	MCN	0.198	30		0	
2005	LGS	0.001	10		0	

Notes for Tables H-1 to H-7:

Column descriptions

Handle: number of fish captured (or obtained from others), handled, and released

% of listed run: estimated take of ESA-listed fish expressed as a proportion of the listed population/location

Mortality: number of fish unintentionally killed as a result of handling or tagging

Lethal: number of fish intentionally killed

Location abbreviations

HAN	Hanford Reach
HCY	Hell's Canyon
MH	McCall Hatchery
WhT	Whitebird Trap
GrT	Lower Grande Ronde Trap
LeT	Lewiston Trap
LGR	Lower Granite Dam
LGS	Little Goose Dam
LMN	Lower Monumental Dam
IHR	Ice Harbor Dam
MCN	McNary Dam
JDA	John Day Dam
TDA	The Dalles Dam
BON	Bonneville Dam
EST	Columbia River Estuary

[#]s in 2000: estimated take of ESA-listed fish in 2000 expressed as a whole number

Tag: number of fish captured (or obtained from others), handled, tagged/marked, and released

Table H-2. Annual-take estimates of ESA-listed juvenile salmonids: SR spring/summer chinook salmon.

			На	ndle							
		% of li	sted run	#s in	2000	T	ag	Mor	tality	Le	thal
Research Action	Location	Art- Prop	Nat- Prod								
900	JDA	0.061	0.033	197	300	1,310	2,002	28	43		
946	EST	3.918	2.964	12,610	27,158			4	9		
996	IHR	0.203	0.110	655	1,005			7	10		
1036	HCY	1.8977	2.6151	2,650	10,400	2,500	10,000	52	205		
	LGR	0.0715	0.1258	100	500			0	0		
	LGS	0.1310	0.2237	100	500			0	0		
	LMN	0.1132	0.2585	100	300			0	0		
1130	MCN	0.077		72		72	0	4	0		
1136	LGR	0.0018	0.0020	246	780	4	0	7	23	12	0
	LGS	0.0019	0.0002	138	33			4	1	0	238
	MCN	0.0001	0.0001	3	4			0	0		
	JDA	0.0015	0.0017	13	23			0	1		
	BON	0.0004	0.001	3	11	2	0	0	0		
1193	WhT	004.3	000.9	13,800	8,200	1,200	3,200	300	228		
	GrT	001.9	000.3	6,000	2,500	1,400	1,800	148	86		
	LeT	001.6	000.5	5,000	5,000	1,200	2,800	124	156		
	LGR	005.0	004.3	16,000	39,000			320	780		
	LGS	002.2	002.1	7,000	19,000			140	380		
	LMN	002.2	001.3	7,000	12,000			140	240		
	MCN	002.5	000.7	8,000	6,800			160	136		
	JDA	000.9	000.2	3,000	2,000			60	40		
	BON	000.4	0.002	1,400	1,700			28	34		
1212	LGR	0.109	0.109	352	1,000	3,515	10,000	74	210		
	LMN	1.849	0.853	5,950	7,814	4,267	0	145	78		
	MCN	0.006	0.003	18	27	359	549	7	11		
1240	LGR	0.052	0.001	73	350	176	0	10	14	9	0
1241	MCN	1.06	2.010	433	1,256	93	0	21	38	9	0
1242	LGR	36.661	1.701	117,987	15,587	100	71,500	1,182	1,742		
1243	LMN	0.423	0.738	1,360	6,762	3,871	0	72	68		
1244	MH	0.510	0.000	1,000	0	75,000	0	1,510	0		
	IHR	1.470	0.793	4,732	7,266			47	73		
	MCN	1.454	0.782	4,679	7,163			46	73	4	
	JDA	0.067	0.036	216	330			2	3	26	40
	BON	0.035	0.019	113	172	5	7	0	1	79	122
2002	LGR	0.004	0.000	14	0	42	0	1	0		
	LGS	0.685	0.704	2,205	6,450	2,663	0	75	65		
2003	MCN	0.697	0.375	2,243	3,433	4,485	6,866	112	171		
2004	EST	0.000	0.000	1	3			0	0		
2005	LGS	0.001	0.001	25	25			0	0		
2006	LGR	0.0100	0.0100	15	42			0	0		
	LGS	0.0100	0.0200	15	43			0	0		
	MCN	0.0200	0.0200	9	14			0	0		
	JDA	0.0300	0.0400	3	5			0	0		
	TDA	0.0090	0.0120	2	4			0	0		
	BON	0.0640	0.0590	5	7			0	0		

Table H-3. Annual-take estimates of ESA-listed juvenile salmonids: SR fall chinook salmon.

Research		Hand	le			
Action	Location	% of Listed Run	#s in 2000	Tag	Mortality	Lethal
900	JDA	0.011	74	286	7	
946	EST	0.777	5,265		4	
996	IHR	0.068	462		5	
1036	HCY	3.3315	11,550	10,400	230	
	LGR	0.1442	500	400	10	
	LGS	0.4501	500		0	
	LMN	0.6166	300		0	
	MCN	0.3319	50		0	2
	JDA	1.0513	50		0	2
1130	MCN	0.033	5	10	1	
1136	LGR	0.0008	73	29	3	118
	LGS	0.0000	0		0	
	MCN	0.0000	0	1	0	1
	JDA	0.0003	1		0	
	BON	0.0000	0	1	0	1
1193	WhT	0.0100	100		2	
	GrT	0.0600	400		2	
	LeT	0.0100	100		8	
	LGR	5.9000	40,000		800	
	LGS	5.1700	35,000		700	
	LMN	4.4300	30,000		600	
	MCN	0.3000	2,000		40	
	JDA	0.0700	500		10	
	BON	0.0300	200		4	
1212	LGR	0.017	118		1	
	LMN	1.858	12,586	6,936	265	
	MCN	0.004	25	200	4	
1240	LGR	0.043	148	295	18	47
1241	MCN	1.63	246	11	10	1
1242	LGR	0.295	2,000		20	
1243	LMN	1.229	8,323	30,001	684	
1244	IHR	0.231	1,567		16	
	MCN	0.121	820		9	
	JDA	0.008	51		0	8
	BON	0.000	2		0	1
2002	LGS	0.057	386		4	
2003	MCN	0.011	75	500	11	
2004	EST	0.001	7		0	1
2005	LGS	0.001	15		0	
2006	LGR	0.06	197		2	
	LGS	0.18	197		2	
	MCN	0.02	3		0	
	JDA	0.042	2		0	
	TDA	0.078	2		0	
	BON	0.042	1		0	

Table H-4. Annual-take estimates of ESA-listed juvenile salmonids: SR steelhead.

Research		Hand				
Action	Location	% of Listed Run	#s in 2000	Tag	Mortality	Lethal
900	JDA	1.008	7,486		37	
946	EST	3.281	19,444		6	
996	IHR	0.111	656		7	
1036	HCY	0.1525	524		10	
1136	LGR	0.0008	257	72	10	
	LGS	0.0004	33		1	119
	MCN	0.0001	1		0	
	JDA	0.0013	24		1	
	BON	0.0011	9		0	
1193	WhT	0.100	500	1,400	38	
	GrT	0.400	2,500	1,200	64	
	LeT	0.300	2,000	1,400	78	
	LGR	1.700	10,000		200	
	LGS	0.800	5,000		100	
	LMN	0.500	3,000		60	
	MCN	0.300	1,500		30	
	JDA	0.100	850		17	
	BON	0.100	500		10	
1212	LGR	0.169	1,000	10,000	110	
	LMN	1.061	6,289		63	
	MCN	0.025	146		1	
1240	LGR	0.001	350	700	32	
1241	MCN	0.130	1,684		34	
1242	LGR	6.915	40,984	94,000	1,350	
1243	LMN	0.865	5,129		51	
1244	IHR	4.348	25,770		258	
	MCN	1.824	10,813		108	
	JDA	0.255	1,897		19	24
	BON	0.082	487		2	276
2002	LGR	0.000	0		0	
	LGS	1.663	9,853		99	
2003	MCN	1.440	8,533	11,378	199	
2004	EST	0.011	62		0	
2005	LGS	0.001	30		0	
2006	LGR	0.0060	19		0	
	LGS	0.0200	20		0	
	MCN	0.0900	12		0	
	JDA	0.0100	2		0	
	TDA	0.0060	2		0	
	BON	0.2400	2		0	

Table H-5. Annual-take estimates of ESA-listed juvenile salmonids: UCR spring chinook salmon and UCR steelhead.

			Han	d le		Ta	ıg	Mort	tality	Letl	hal
		% of List	ted Run	#s in 2	2000				-		
Research		Art-	Nat-	Art-	Nat-	Art-	Nat-	Art-	Nat-	Art-	Nat-
Action	Location	Prop	Prod	Prop	Prod	Prop	Prod	Prop	Prod	Prop	Prod
			Ţ	JCR Sprii	ng Chino	ok Salmo	n				
900	JDA	0.123	0.018	1,607	111	10,711	739	230	16		
946	EST	1.821	0.270	23,730	1,647			8	1		
1036	HAN	0.1699	0.3052	1,628	202			6	3		
1130	MCN	0.077	0	257	0	588	0	34	0		
1136	MCN	0.0001	0.0001	21	2			1	0		
	JDA	0.0015	0.0018	104	9			3	0		
	BON	0.0004	0.0010	21	4	9	0	1	0		
1193	MCN	1.400	7.600	12,000	4,500			240	90		
	JDA	0.200	1.000	1,500	600			30	12		
	BON	0.100	0.400	600	250			12	5		
1212	MCN	0.011	0.002	147	10	2,933	203	60	4		
1241	MCN	1.06	2.010	3,538	464	756	0	172	19	71	0
1244	MCN	2.935	0.433	38,248	2,644			383	26	36	
	JDA	0.135	0.020	1,766	122			18	1	212	15
	BON	0.071	0.011	922	64	39	3	4	0	652	45
2003	MCN	1.407	0.208	18,332	1,267	36,665	2,534	916	64		
2004	EST	0.001	0.000	14	0			0	0		
2006	MCN	0.0200	0.0200	73	5			1	0		
	JDA	0.0300	0.0400	22	2			0	0		
	TDA	0.0100	0.0080	20	1			0	0		
	BON	0.0610	0.0680	39	3			0	0		
				UC	R Steelh	ead					
900	JDA	4.531	4.698	49,508	11,956			248	60		
946	EST	1.711	1.714	18,700	3,481			6	1		
1036	HAN	0.025	0.032	200	49			2	2		
1130	MCN	0.448	0	497	0	1,177	0	50	0		
1136	MCN	0.0001	0.0001	8	2			0	0		
	JDA	0.0009	0.0013	134	37			4	1		
	BON	0.0008	0.0011	50	14	95	0	4	0	91	0
1193	MCN	2.200	3.800	16,000	5,100			320	102		
	JDA	1.200	2.200	9,000	2,900			180	58		
	BON	0.700	1.200	5,100	1,600			102	32		
1212	MCN	0.108	0.115	1,177	233			12	2		
1241	MCN	7.91	0.047	8,783	6,189	1,883	0	360	186	198	0
1244	MCN	8.640	8.505	94,422	17,269			945	173	95	
	JDA	1.190	1.147	12,544	3,030			126	31	157	38
	BON	0.369	0.383	4,031	778			17	3	2,290	442
2003	MCN	6.819	6.711	74,513	13,628	99,350	18,170	1,739	318		
2004	EST	0.000	0.006	0	11			0	0		
2006	MCN	0.0900	0.0900	99	18			1	0		
	JDA	0.0100	0.0100	16	3			0	0		
	TDA	0.0050	0.0060	14	3			0	0		
	BON	0.0170	0.0150	12	2			0	0		

Table H-6. Annual-take estimates of ESA-listed juvenile salmonids: MCR steelhead, UWR chinook salmon, and UWR steelhead.

Research		Handl	e			
Action	Location	% of Listed Run	#s in 2000	Tag	Mortality	Lethal
		MC	R Steelhead			
900	JDA	8.060	23,984		120	
946	EST	5.552	9,663		3	
1136	MCN	0.0001	1		0	
	JDA	0.0013	93		3	
	BON	0.0024	48		1	
1193	MCN	1.900	1,300		26	
	JDA	5.000	3,500		70	
	BON	3.600	2,500		50	
1212	MCN	0.174	121		1	
1241	MCN	0.130	1,388		28	
1244	MCN	12.841	8,915		90	
	JDA	2.042	6,077		61	76
	BON	1.516	2,587		12	1,470
2003	MCN	10.133	7,036	9,381	164	
2004	EST	0.018	31		0	
2006	MCN	0.090	9		0	
	JDA	0.010	8		0	
	TDA	0.005	8		0	
	BON	0.020	9		0	
		UWR C	Chinook Salmon			
946	EST	3.303	82,675		26	
2004	EST	0.000	8		0	
			R Steelhead			
946	EST	3.362	6,186		2	
2004	EST	0.011	20		0	

Table H-7. Annual-take estimates of ESA-listed juvenile salmonids: LCR chinook salmon, LCR steelhead, and CR chum salmon.

Research		Hand	le			
Action	Location	% of Listed Run	#s in 2000	Tag	Mortality	Lethal
		LCR Ch	inook Salmon			
946	EST	32.576	189,864		90	
1136	BON	0.0009	51	6	2	24
1193	BON	1.700	3,593		72	
1241	BON	2.070	4,375	140	181	33
1244	BON	0.268	1,536	36	6	1,034
2001	BON	0.940	235		0	
2004	EST	0.003	11		0	17
2006	TDA	0.072	113		1	
	BON	0.072	113		1	
		LCR S	Steelhead			
946	EST	3.361	7,629		2	
1136	BON	0.0012	6		0	
1193	BON	0.900	304		7	
1241	BON	1.300	439		9	
1244	BON	0.935	318		1	181
2004	EST	0.011	24		0	
2006	TDA	0.180	1		0	
	BON	0.018	1		0	
		CR C	hum Salmon			
946	EST	3.302	16,531		5	_
2001	BON	1.000	340		0	
2004	EST	0.002	50		1	

H.3 ESTIMATES OF TAKE ASSOCIATED WITH ADULT RESEARCH AND MONITORING

Adult passage research and monitoring activities are also required by the RPA. Most of the research and monitoring activities identified in this biological opinion will take place on the mainstem lower Columbia and Snake rivers, at the mainstem Federally operated hydropower dams, and in major tributary streams. The scientific research and monitoring activities, compared with the overall results of FCRPS operation, will have relatively small effects on ESA-listed species and will not exceed those already estimated through other means (e.g., radio-telemetry and PIT-tag conversion rates). Estimates of the take of downstream migrating adult steelhead (kelts) would not change the estimates in Table 9.7-2, given the low survival of these fish to repeat spawning (see Section 6.2.4.1.1). The application of information resulting from research and monitoring efforts is expected to benefit the survival of ESA-listed species.

Some scientific research and monitoring activities evaluated in the take tables that follow (Tables H-8 and H-9) are multiyear projects that will require annual takes of ESA-listed species. NMFS must assess the cumulative impacts to ESA-listed anadromous fish species resulting from annual research and monitoring. Cumulative impacts on ESA-listed fish are best expressed as total annual rates of mortality per individual ESU. To assess annual cumulative impacts due to scientific research and monitoring, NMFS will require each action agency (or its designated contract researcher) to submit a take report at the end of each annual sampling season. On the basis of the annual report, each research and monitoring activity will be subject to annual authorization by NMFS. For fish research and monitoring on the mainstem rivers, a cumulative impact assessment is not sensitive enough to evaluate the effects of scientific research and monitoring activities on ESA-listed salmonids at the population level. Annual cumulative impact analyses will treat the effects on ESA-listed fish populations the same as effects on the ESU as a whole.

Annual-take estimates of ESA-listed adult salmonids associated with scientific research activities are derived using an estimate of the relative abundance for each species at selected mainstem hydropower dams on the Snake and Columbia rivers. Annual abundance estimates of adult salmonids are determined from adult fishway counts at the dams in previous years and from projections of adult salmonid returns. Annual abundance estimates of adult salmonids can vary significantly from year to year and depend on factors such as smolt survival, aquatic conditions (in nursery areas, the mainstem migration corridor, and the ocean), climatological conditions, and incidental harvest impacts.

Table H-8. Annual-take estimates of ESA-listed adult salmonids: Snake River ESU.

Research Action	Location	Hand le	Tag	Mortality
	S	Sockeye Salmon	ı	
994	LGR		35	1
	BON		18	0
1194	LGR	59		1
2007	BON		1	0
	Spring/S	ummer Chinool	Salmon	
994	LGR		150	2
	BON		420	4
996	IHR	23		1
1036	НСҮ	5		0
1194	LGR	107	70	2
	MCN	24	21	0
	JDA	6	18	0
	TDA	6	16	0
	BON	4	6	0
2006	LGR	14		0
2007	BON		35	0
	Fal	ll Chinook Salm	on	
994	LGR		100	1
	BON		44	0
996	IHR	20		1
1036	HCY	3		0
1058	LGR	220	10	2
1194	LGR	39		0
2005	LGS	2		0
2006	LGR	5		0
2007	BON		4	0

Table H-8 (continued). Annual-take estimates of ESA-listed adult salmonids: Snake River ESU.

Research Action	Location	Handle	Tag	Mortality
		Steelhead		
994	LGR		300	3
	BON		112	1
996	IHR	10		0
1036	HCY	5		0
1194	LGR	100		1
	MCN	29		0
	JDA	15		0
	TDA	13		0
	BON	12		0
1224^{1}	MCN	115	105	2
	JDA	50	50	1
2000^{1}	LGR	400	2,600	30
	LGS	900		9
	LMN	450		5
	MCN	250		3
2005	LGS	2		0
2006	LGR	7		0
2007	BON		20	0

¹Downstream migrating adult (kelt) studies

Notes for Tables H-8 and H-9:

Column descriptions

Handle: number of fish captured (or obtained from others), handled, and released

Tag: number of fish captured (or obtained from others), handled, tagged/marked, and released

Mortality: number of fish unintentionally killed as a result of handling or tagging

Location abbreviations

HAN Hanford Reach HCY Hells Canyon Lower Granite Dam LGR LGS Little Goose Dam LMN Lower Monumental Dam IHR Ice Harbor Dam MCN McNary Dam JDA John Day Dam TDA The Dalles Dam BON Bonneville Dam

Table H-9. Annual-take estimates of ESA-listed adult salmonids: UCR, MCR, and LCR ESUs.

Research Action	Location	Hand le	Tag	Mortality
	UCR Sp	ring Chinook S	almon	
994	BON		153	2
1036	HAN	10		0
1194	MCN	25	168	2
	JDA	16	149	2
	TDA	14	129	2
	BON	6	51	1
2006	MCN	21		0
2007	BON		18	0
	Ī	UCR Steelhead		
994	BON		55	1
1036	HAN	19		0
1194	MCN	94	471	6
	JDA	66	418	5
	TDA	57	369	4
	BON	52	329	4
1224^{1}	MCN	3	3	0
2000^{1}	MCN	200		2
2006	MCN	20		0
2007	BON		5	0
	I	MCR Steelhead		
994	BON		23	0
1194	MCN	24		0
	JDA	61		1
	TDA	68		1
	BON	62		1
12241	MCN	42	42	1
	JDA	115	15	1
2000^{1}	MCN	300		3
2006	MCN	2		0
2007			2	0
	LC1	R Chinook Saln	10 n	
994	BON		11	0
1194	BON	24		0
2006	BON	4		0
2007	BON		2	0
		LCR Steelhead		
994	BON		3	0
1194	BON	8		0
2006	BON	2		0
2007	BON		1	0

¹Downstream migrating adult (kelt) studies

H.4. REFERENCES

- NWPPC (Northwest Power Planning Council). 1994. Columbia River basin fish and wildlife program. NWPPC, Portland, Oregon. December.
- Schiewe, M. 2000. Memorandum re: estimation of percentages for listed Pacific salmon and steelhead smolts arriving at various locations in the Columbia River basin in 2000, to D. R. Knowles. March 16.

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